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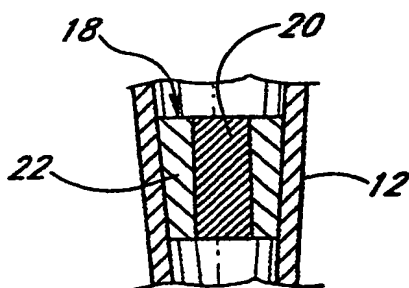
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- (71) Applicant: TAYLOR MADE GOLF COMPANY, INC.
[US/US]; 5545 Fermi Court, Carlsbad, CA 92008 (US).
- (72) Inventors: BEACH, Todd; 3687 Foxgrove Place, San Diego, CA 92130 (US). BRUNETTE, David; 538 Edna Way, Vista, CA 92083 (US). DECHIELL, Drew, T.; 840 Turquoise Street #311, San Diego, CA 92109 (US).
- (74) Agent: ALTMAN, Daniel, E.; Knobbe, Martens, Olson & Bear, LLP, 16th Floor, 620 Newport Center Drive, Newport Beach, CA 92660 (US).
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(54) Title: METHOD FOR LOCALIZING WEIGHT IN A GOLF CLUB SHAFT



(57) Abstract: The invention includes a golf club (10) having a club head (14) and a tubular shaft (12) connected to the club head (14). A separate weight (20) having a density higher than the shaft (12) is located within the shaft (12). A material (22) having a rigidity significantly less than the rigidity of the shaft (12) is interposed between the shaft (12) and the weight (20). A method for making such a golf club (10) includes providing a golf club shaft (12) and disposing an expandable material (21) about the weight (20). The weight (20) and the expandable material (21) are inserted into the shaft (12) of the golf club (10). The expandable material (21) is then expanded such that the expandable material (21) expands and secures the weight (20) to the shaft (12). In another arrangement, the weight (20) is co-molded with an intermediate (22) material having a rigidity significantly less than the rigidity of the shaft (12).

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METHOD FOR LOCALIZING WEIGHT IN A GOLF CLUB SHAFT

Background of the InventionField of the Invention

5 The present invention relates to an improved golf club and a method for making such a golf club and, in particular, to a golf club having one or more weight assemblies positioned within the shaft of the golf club and a method for making a golf club with one or more weight assemblies within the golf club shaft.

Description of the Related Art

A golf club typically includes a shaft with a golf club head attached to the lower end of the shaft. The top of the shaft is typically covered with a handle to facilitate gripping the golf club.

10 The current trend in the industry is to produce light-weight golf clubs. These light weight golf clubs typically include hollow light-weight shafts that are made of strong yet light-weight materials such as carbon fiber composites. Light-weight clubs tend to produce longer and more accurate golf ball shots.

It has been suggested that the performance of these light-weight golf clubs can be further improved by localizing weight at specific locations along the longitudinal axis of the shaft. For example, U.S. Patent No. 5,569,097
15 discloses a light weight golf club with weight localized at a specific locations along the longitudinal axis of the golf club shaft. The localized weight improves the dynamic balancing of a light-weight golf club and produces a better swing feel in the club.

Weight is typically localized in a golf club by securing weights at specific locations on a golf club shaft. However, means for securing a weight to a golf club shaft have to date been unsatisfactory. For example, U.S. Patent
20 No. 5,569,097 discloses a weight formed from an elastomer or other deformable material that has been inserted into the cavity of the golf club shaft. The weight fills the cavity of the shaft such that the outer diameter of the mass contacts the inner diameter of the shaft. This method has several disadvantages. For example, the elastomer or deformable material is typically more rigid than the golf club shaft; therefore, this method significantly increases the rigidity of the golf club. Furthermore, it may be desirable to use a material significantly denser than an elastomer such
25 as tungsten. Such a material would typically be significantly more rigid than an elastomer. Accordingly, such a tungsten weight would unacceptably increase the rigidity of the golf club.

Another method for localizing weight, consists of placing a ring-shaped weight on the external surface of the shaft. However, these rings typically produce stress concentrations in the shaft when the shaft is flexed. It has also
30 been suggested that the weight be incorporated into the internal structure of the shaft. For example, the weight could be incorporated into the layers of composite material that typically form the shaft. However, this method may cause discontinuity within the fibers of the shaft that can cause the shaft to break.

Summary of the Invention

The aforementioned disadvantages are addressed by a weight assembly that simply and effectively secures a weight at a specific longitudinal location in the shaft without significantly affecting the flexibility or physical integrity
35 of the golf club shaft.

Accordingly, one aspect of the of the present invention involves a golf club that includes a club head and a tubular shaft connected to the club head. A separate weight having a density higher than the shaft is located within the shaft. A material having a rigidity significantly less than the rigidity of the shaft is interposed between the shaft and the weight.

5 Another aspect of the of the present invention involves a golf club that includes a club head and a tubular shaft connected to the club head. A separate weight having a density higher than the shaft is located within the shaft. An expanded material is interposed between the shaft and the weight.

Yet, another aspect of the present invention involves a method for making a golf club that includes the steps of providing a golf club shaft and disposing an expandable material about a weight having a density higher than the shaft.
10 The weight and the expandable material are inserted into the shaft of the golf club. The expandable material is then expanded such that the heat expandable material expands and secures the weight to the shaft.

For purposes of summarizing the invention and the advantages achieved over the prior art, certain objects and advantages of the invention have been described herein above. Of course, it is to be understood that not necessarily all such objects or advantages may be achieved in accordance with any particular embodiment of the invention. Thus, for
15 example, those skilled in the art will recognize that the invention may be embodied or carried out in a manner that achieves or optimizes one advantage or group of advantages as taught herein without necessarily achieving other objects or advantages as may be taught or suggested herein.

All of these embodiments are intended to be within the scope of the invention herein disclosed. These and other embodiments of the present invention will become readily apparent to those skilled in the art from the following detailed
20 description of the preferred embodiments having reference to the attached figures, the invention not being limited to any particular preferred embodiment(s) disclosed.

Brief Description of the Drawings

These and other features of the invention will now be described with reference to the drawings of the preferred embodiments, which are intended to illustrate and not to limit the invention, and in which:

25 Figure 1 is a perspective view of a golf club having a weight assembly with certain features and advantages in accordance with the present invention;

Figure 2 is an enlarged sectional view of the weight assembly shown in Figure 1;

Figure 3 is a sectional view of the weight assembly taken along line 3-3 of Figure 2;

Figure 4 is a sectional view of the weight assembly taken along line 4-4 of Figure 2;

30 Figure 5 is a perspective view of several golf clubs illustrating alternative arrangements of the present invention;

Figure 6A is a perspective view of an embodiment of the weight assembly being formed in a mold;

Figure 6B is a perspective view of an embodiment of the weight assembly;

Figure 7 is a perspective view of another embodiment of the weight assembly being formed in a mold;

Figure 8A is a sectional view of another embodiment of a weight assembly located within a golf club shaft;

35 Figure 8B is a sectional view of another embodiment of a weight assembly located within a golf club shaft;

Figure 9 is a perspective view of an expandable material having certain features and advantages in accordance with present invention;

Figure 10 is a perspective view of another embodiment of a weight for a weight assembly having certain features and advantages according to the present invention;

5 Figure 11 is a perspective view of another embodiment of a weight for a weight assembly having certain features and advantages according to the present invention;

Figure 12 is a schematic cross-sectional view illustrating an embodiment of the weight assembly and the golf club shaft under flexed and un-flexed conditions.

10 Figure 13 is a schematic cross-sectional view illustrating another embodiment of the weight assembly under flexed and un-flexed conditions.

Detailed Description of the Preferred Embodiment

Figure 1 illustrates a golf club 10 that includes a weight assembly 18 having certain features, aspects, and advantages in accordance with the present invention. The golf club 10 comprises a golf club head 14 having a club face 15. The club face 15 is used to strike a golf ball. The club head 14 that is illustrated is a "wood-type" head; however, it should be appreciated that the golf club 14 could also be any type of club including an "iron" or a "putter".

15 The golf club 10 also includes a shaft 12 that is connected to the club head 14 by means well known in the art. The shaft 12 is preferably tubular and may be made from a variety of materials commonly known in the art. Preferably, the shaft 12 is made of a light-weight material such as a carbon fiber and organic resin-based composite. Such composite shafts can be produced by conventional methods well known by one of ordinary skill in the art. The shaft 12 also includes a handle or grip 16 at the end of the shaft opposite the club head 14. A golfer holds the golf club 10 by the grip 16 when using the golf club 10.

20 A weight assembly 18 is positioned within the shaft 12. As best seen in Figures 3 and 4, the weight assembly 18 includes a weight 20 and an intermediate material 22 that is interposed between the shaft 12 and the weight 20. As seen in Figure 1, the weight assembly 18 is located at about the longitudinal center of the golf club shaft 12. However, it is an advantage of this invention that the weight assembly can be located at any point along the longitudinal axis of the golf club shaft 12. Accordingly, as shown in Figure 5, the weight assembly 18 can be positioned within a region close to the golf club head 14. Alternatively, the weight assembly 18 may be positioned in a region that is close to the end opposite the golf club head 14. In yet another arrangement, a plurality of weight assemblies 18 may be positioned at more than one location within the shaft 12. The number of weight assemblies 18 and their location are determined by the desired performance characteristics of the golf club 10.

30 The weight 20 is comprised of a material that is denser than the shaft 12. More preferably, the weight 20 is comprised of a material that is denser than the intermediate material 22. Accordingly, the weight has a density in the range of 2.0 - 21.0 grams per centimeter cubed (g/cc). More preferably, the weight 18 has a density in the range of 8.0 - 20.0 g/cc.

Most desirable materials for the weight 20 will have a modulus of elasticity, E, that is larger than the intermediate material 22. The material for the weight 20 will also desirably have a modulus of elasticity, E, that is greater than or about the same as the golf club shaft 12. In the preferred embodiment, the material for the weight 20 has a modulus of elasticity, E, of approximately 8×10^6 – 90×10^6 pounds per square inch (psi).

5 In the preferred embodiment, the weight 20 comprises a heavy metal, such as, for example, tungsten, which has the above-mentioned properties. For the weight assembly 18 to be effective, the weight assembly 18 preferably has a mass greater than 15 grams. More preferably the weight assembly has a mass greater than 20 grams and less than 35 grams. Most preferably, the weight assembly has a mass of 25 grams.

10 The weight 20 is generally centered about the longitudinal axis I of the golf club shaft 12. The weight 20 also desirably has an elongated and, preferably, generally cylindrical shape. An elongated and cylindrical shape is preferred because such a shape positions most of the weight's 20 mass close to the longitudinal axis I of the shaft 12. Such a shape also distributes the mass symmetrically about this longitudinal axis. However, it should be appreciated that several advantages of the present invention can be achieved with weights 14 of other shapes, such as, for example, spheres, cubes, elongated cubes, etc. It should also be appreciated that the weight 20 of the assembly 18 could consist of a
15 plurality of separate weights. Such an arrangement further reduces the influence of the weight 20 on the stiffness of the shaft 12 as will be explained below.

As will be explained below, it is desirable that the outer diameter of the weight 20 be at least 1 millimeter (mm) smaller than the inner diameter of the shaft 12. More preferably, the outer diameter of the weight 20 is at least 2 mm smaller than the inner diameter of the shaft 12. Accordingly, the length of the weight 20 is determined by the maximum
20 outer diameter of the weight 20, the shape of the weight 20, desired mass of the weight 20, and the density of the weight 20 material.

Interposed between the shaft 12 and the weight 20 is the intermediate material 22. The intermediate material 22 is preferably significantly less rigid than the shaft 12. More preferably, the intermediate material 22 has a rigidity of approximately 100 times less than the rigidity of the shaft 12. Most preferably, the intermediate material 22 has a rigidity
25 of approximately 1000 times less than the rigidity of the shaft 12. As will be explained below, because the intermediate material 22 is significantly more flexible than the shaft 12, the intermediate material 22 does not significantly increase the rigidity of the golf club 10.

Golf clubs can be subjected to harsh conditions, such as, for example, (i) hot and cold temperatures and (ii) severe stresses and vibrations. Accordingly, the intermediate material 22 and the weight 20 should be sufficiently durable
30 such that they do not significantly degrade when subjected to relatively high or low temperatures. Furthermore, the intermediate material 22 must be sufficiently resilient to withstand the stresses and vibrations encounter by the golf club 10.

In one embodiment, the intermediate material 22 comprises a non-rigid polymer, such as, for example, a urethane or a rubber with the above-mentioned characteristics. In accordance with certain of the features and advantages of the

present invention, several methods for forming the weight assembly 18 and securing the weight assembly to the shaft 12 will now be described.

As shown in Figure 6A, the non-rigid polymer intermediate material 22 can be formed around the weight 18 in a mold 237. As the intermediate material 22 solidifies, a bond is formed between the weight 18 and the intermediate material. This bond secures the weight 18 within the weight assembly 18. After the weight assembly 18 is removed from the mold 23, an adhesive 25 is applied to the outer surface 27 of the weight assembly 18 (see Figure 6B). The weight assembly 18 then is inserted into the shaft 12, positioned at the desired longitudinal location, and held in place with positioning rods (not shown). The adhesive 25 is then cured to form a bond between the weight assembly 18 and the shaft 12.

Several different approaches can be used for curing the adhesive 25. For example, the weight assembly can be held in place as the adhesive 25 is cured overnight at room temperature. If accelerated curing is desired, the shaft 12 and the weight assembly 19 can be placed in an oven and cured at an elevated temperature. Alternatively, the adhesive 23 can be cured by using induction coils placed around the shaft 12 where the weight assembly 19 is located. In such an arrangement, metal particles can be added to the adhesive to aid the curing process.

Another method for forming the weight assembly 18 includes forming the non-rigid polymer material 22 in a mold 23 that includes a central cavity 29 (see Figure 7A). As shown in Figure 7B, the solidified intermediate material 23 includes an inner bore 31. An adhesive 25 can then be applied to the outer surface 27 of the intermediate material 22. The intermediate material 22 is inserted into the shaft 12 and held in place with positioning rods (not shown). The adhesive 25 can be cured as described above.

The weight 20 is secured to the intermediate material 22 by inserting the weight into the inner bore 31 before or after the intermediate material 22 is placed into the shaft 12. Preferably, the weight 20 has an outer diameter that is sized and dimensioned to form an interference fit with the inner bore 31. This interference fit secures the weight 20 within the intermediate material 22. In an additional embodiment, an adhesive can be used to secure the weight 20 to the intermediate material 22. In such an embodiment, the weight 20 can be secured to the intermediate material 22 before or after the intermediate material is attached to the shaft 12. To aid the positioning of the weight 18 within the intermediate material 22, the intermediate material 22 can include a bottom portion 33 (see Figure 8A). The bottom portion 33 prevents the weight 20 from being inserted too far into the intermediate material 22. It should be appreciated that although the illustrated bottom portion 33 completely closes the inner bore 31, the bottom portion 33 can be formed with a hole with a diameter that is smaller than the diameter of the weight 20.

In another embodiment of the present invention, the weight 20 can be completely co-molded within the intermediate material 22 (see Figure 8B). It should be appreciated that there could be small holes in the intermediate material 22 to help position the weight during the molding process.

In another embodiment of the present invention, the intermediate material 22 comprises a foam. Preferably, the foam 22 is a closed cell or syntactic foam. Closed cell foams are preferred over open cell foams because they absorb less moisture. Furthermore, closed cell foams have relatively good compressive strength, which is desired in this application.

In accordance with certain features and advantages of the present invention, a method for forming the weight assembly 18 utilizing an intermediate material 22 comprising a foam will now be described. As shown in Figure 9, the weight 20 is first wrapped with an expandable material 31. The diameter of the weight assembly 18 at this stage is less than the inner diameter of the golf club shaft 10. In the preferred embodiment, the expandable material 31 comprises an epoxy film with a foaming agent therein. An example of such an expandable material is an 301 epoxy with foaming agent, which sold by Newport Adhesives and Composites, Inc. of Irvine, CA.

The weight 20 and the expandable material 31 are inserted into the cavity of a shaft 12. Once the weight 20 and the expandable material 31 are in the proper longitudinal position, the expandable material 31 is heated. The heat causes the foaming agent in the expandable material 31 to foam, which causes the epoxy to expand. After a specific time at a specific temperature, the epoxy solidifies to form a closed cell foam. The epoxy foam also forms a bond with the weight 20 and the inner surface of the shaft 12, which secures the weight 20 to the shaft 12.

Figures 10 and 11 illustrate additional embodiments for the weight 20. In Figure 10, the weight 20 includes a spiral ridge 24. The ridge 24 helps to prevent the weight 20 from slipping within the weight assembly 18 and may also provide additional surface area to which the intermediate material 22 and/or adhesive 25 can bond. Figure 11 illustrates another weight 20 that includes a plurality of ridges 24 and indentations 26, which also help to prevent the weight from moving within the weight assembly 18.

As mentioned above, one advantage of the present invention is that the weight assembly 18 does not significantly affect the flexibility of the golf club 10. Figure 12 illustrates a section of a golf club 10 with a weight assembly 18 according to the present invention. The golf club shaft 12 is illustrated in an un-flexed position by solid lines and a flexed position by dashed lines. When the shaft 12 is subjected to a certain amount of flexion about the bending moment X , the walls of the shaft are deflected a certain distance y_1 , with respect to the longitudinal axis l . In use, a golf club shaft 12 is typically flexed a relatively small amount. Accordingly, the neutral axis of the shaft 12 lies relatively close to the longitudinal axis l of the shaft 12. Because the weight 20 is situated generally about the longitudinal axis l and the outer diameter of the weight 20 is sufficiently distanced from the shaft 12 wall, most of the weight 20 lies near the neutral axis of the shaft 12. Therefore, for a given amount of flexion, the areas around the neutral axis deflect a much smaller amount y_2 as compared to the shaft 12.

Because the intermediate material 22 is preferably significantly less rigid than the shaft, most of the deflection y_2 near the weight will be absorbed by the intermediate material 22. That is, the intermediate material 22 will compress and stretch a distance y_2 to compensate for the tendency of the rigid weight 20 to not deflect. As mentioned above, y_2 is relatively small and the intermediate material 22 is significantly more flexible than the shaft; therefore, the additional resistance to flexion caused by the compression of the intermediate material 22 is minimal. Furthermore, any deflection that does occur in the rigid weight 20 will be minimal so as to not significantly affect the golf club's 10 overall resistance to flexion. Accordingly, the weight assembly 18 does not significantly increase the rigidity of the golf club 10.

As mentioned above, the weight assembly 18 can be formed from a plurality of weights 20 (see Figure 13). Such an arrangement further reduces the affect of the weight assembly 18 on the rigidity of the golf club 10 by providing the weight assembly 18 with a bending gap 50 (i.e., the gap between the weights 20).

5 Although this invention has been disclosed in the context of certain preferred embodiments and examples, it will be understood by those skilled in the art that the present invention extends beyond the specifically disclosed embodiments to other alternative embodiments and/or uses of the invention and obvious modifications and equivalents thereof. Thus, it is intended that the scope of the present invention herein disclosed should not be limited by the particular disclosed embodiments described above, but should be determined only by a fair reading of the claims that follow.

WHAT IS CLAIMED IS:

1. A golf club comprising:
a club head;
a tubular shaft connected to said club head and having a density and a rigidity;
5 a separate weight having a density higher than said density of said shaft and located within said shaft; and
a material having a rigidity significantly less than said rigidity of said shaft and interposed between said shaft and said weight.
2. A golf club as set forth in claim 1 wherein said non-rigid material has a rigidity 100 times less than
10 the rigidity of the shaft.
3. A golf club as set forth in claim 1 wherein said non-rigid material has a rigidity 1000 times less than the rigidity of the shaft.
4. A golf club as set forth in claim 1 wherein said weight and said non-rigid material do not significantly impact the rigidity of said shaft.
- 15 5. A golf club as set forth in claim 4 wherein said weight and said non-rigid material increase the local bending stiffness of the shaft by less than 10 percent.
6. A golf club as set forth in claim 1 wherein said non-rigid material is a foam.
7. A golf club as set forth in claim 1 wherein said non-rigid material is a closed cell foam.
8. A golf club set as set forth in claim 1 wherein said non-rigid material is a polymer.
- 20 9. A golf club set as in claim 8 wherein said non-rigid material is rubber or urethane.
10. A golf club as set forth in claim 1 wherein the outer diameter of the weight is at least 1 millimeter smaller than the inner diameter of the shaft.
11. A golf club as set forth in claim 1 wherein said weight is substantially cylindrical.
12. A golf club as set forth in claim 1 wherein said weight comprises a plurality of separate pieces.
- 25 13. A golf club as set forth in claim 1 wherein said weight is shaped such that said weight does not move relative to said non-rigid material.
14. A golf club as set forth in claim 1 wherein said weight includes at least one ridge that is spirally wound around said weight.
15. A golf club as set forth in claim 1 wherein said weight is made of tungsten.
- 30 16. A golf club as set forth in claim 1 wherein said weight has a mass of least 20 grams.
17. A golf club as set forth in claim 1 wherein said weight has a mass no greater than 35 grams.
18. A golf club as set forth in claim 1 wherein said weight has a mass of at between 20 and 35 grams.
19. A golf club as set forth in claim 1 wherein said weight and said non-rigid material is positioned within the shaft such that they are positioned in a tip region of said shaft.

20. A golf club as set forth in claim 1 wherein said weight and said non-rigid material are positioned within the shaft such that they are positioned in a handle region of said shaft.

21. A golf club as set forth in claim 1 wherein said shaft has a top and bottom end and said weight and said non-rigid material are positioned at a point between a tip region and a handle region of said shaft

5 22. A golf club comprising:

a club head;

a tubular shaft connected to said club head and having a density and a rigidity;

a separate weight having a density higher than said density of said shaft and located within said shaft; and

10 an expanded material interposed between said shaft and said weight.

23. A golf club as set forth in claim 22 wherein said expanded material is expanded in response to heat.

24. A golf club as set forth in claim 22 wherein said expanded material is formed from an epoxy film with a foaming agent that is activated when heated.

15 25. A golf club as set forth in claim 22 wherein said expanded material has a rigidity 100 times less than the rigidity of the shaft.

26. A golf club as set forth in claim 22 wherein said expanded material has a rigidity 1000 times less than the rigidity of the shaft.

27. A golf club as set forth in claim 22 wherein said weight and said expanded material do not significantly impact the rigidity of said shaft.

20 28. A golf club as set forth in claim 27 wherein said weight and said non-rigid material increase the local bending stiffness of the shaft by less than 10 percent.

29. A golf club as set forth in claim 22 wherein said expanded material is a foam.

30. A golf club as set forth in claim 22 wherein said expanded material is a closed cell foam.

31. A golf club as set forth in claim 22 wherein said weight is substantially cylindrical.

25 32. A golf club as set forth in claim 22 wherein said weight comprises a plurality of separate pieces.

33. A golf club as set forth in claim 22 wherein said expanded material is spiral wrapped around said weight.

34. A golf club as set forth in claim 22 wherein said weight is shaped such that said weight does not move relative to said heat expanded material.

30 35. A golf club as set forth in claim 22 wherein said weight includes at least one ridge that is spirally wound around said weight.

36. A golf club as set forth in claim 22 wherein said weight is made of tungsten.

37. A golf club as set forth in claim 22 wherein said weight has a mass of least 20 grams.

38. A golf club as set forth in claim 22 wherein said weight has a mass no greater than 35 grams.

39. A golf club as set forth in claim 22 wherein said weight has a mass of at between 20 and 35 grams.

40. A golf club as set forth in claim 22 wherein said weight and said expanded material is positioned within the shaft such that they are positioned in a tip region of said shaft.

5 41. A golf club as set forth in claim 22 wherein said weight and said expanded material are positioned within the shaft such that they are positioned in a handle region of said shaft.

42. A golf club as set forth in claim 22 wherein said shaft has a top and bottom end and said weight and said expanded material are positioned at a point between a tip region and a handle region of said shaft

43. A method for making a golf club comprising the steps of:

10 providing a golf club shaft;

disposing an expandable material about a weight having a density higher than said shaft;

inserting said weight and said expandable material into the shaft of said golf club;

expanding said expandable material such that said expandable material expands and secures said weight to said shaft.

15 44. A method as set forth in claim 43 wherein said expanding step includes heating the expandable material.

45. A method as set forth in claim 43 wherein said heat expandable material includes an epoxy film with a foaming agent therein and said expanding step further comprising heating said expandable material such that said foaming agent foams and expands said epoxy.

20 46. A method as set forth in claim 45 wherein said expanding step includes heating said expandable material to at least 250 degrees Fahrenheit.

47. A method as set forth in claim 45 wherein said expanding step includes heating said expandable material to at least 250 degrees Fahrenheit for at least 60 minutes.

25 48. A method as set forth in claim 43 wherein said shaft includes a tip region, a handle region, and a middle region, further comprising positioning said weight and expandable material in said tip region.

49. A method as set forth in claim 43 wherein said shaft includes a tip region, a handle region, and a middle region, further comprising positioning said weight and expandable material in said handle region.

50. A method as set forth in claim 43 wherein said shaft includes a tip region, a handle region, and a middle region, further comprising positioning said weight and expandable material in said middle region.

30 51. A golf club as set forth in claim 43 wherein said disposing step comprises disposing an expandable material about a weight having a mass of least 20 grams.

52. A golf club as set forth in claim 43 wherein said disposing step comprises disposing an expandable material about a weight having a mass of less than 30 grams.

53. A golf club as set forth in claim 43 wherein said disposing step comprises disposing an expandable material about a weight having a mass between 20 and 35 grams.

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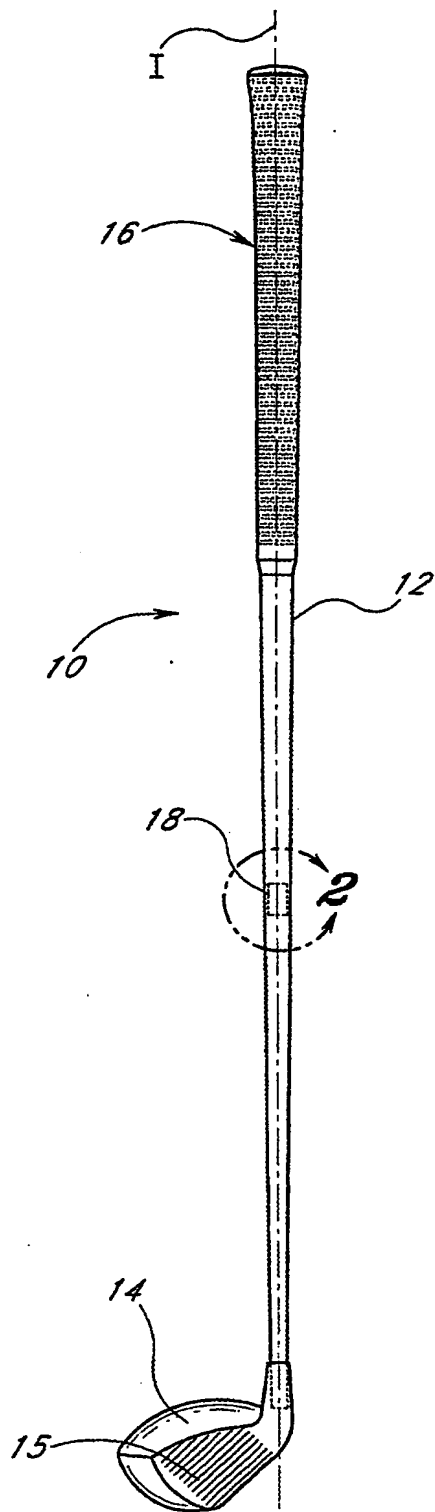


FIG. 1

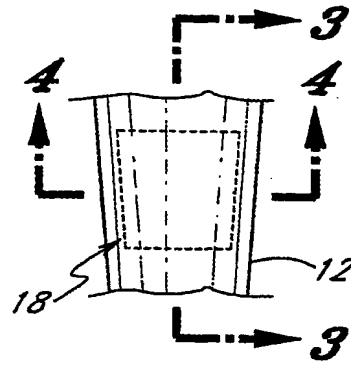


FIG. 2

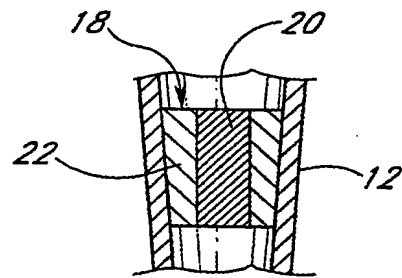


FIG. 3

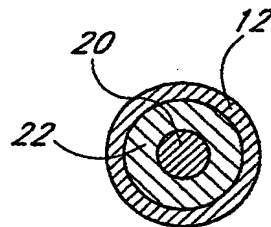


FIG. 4

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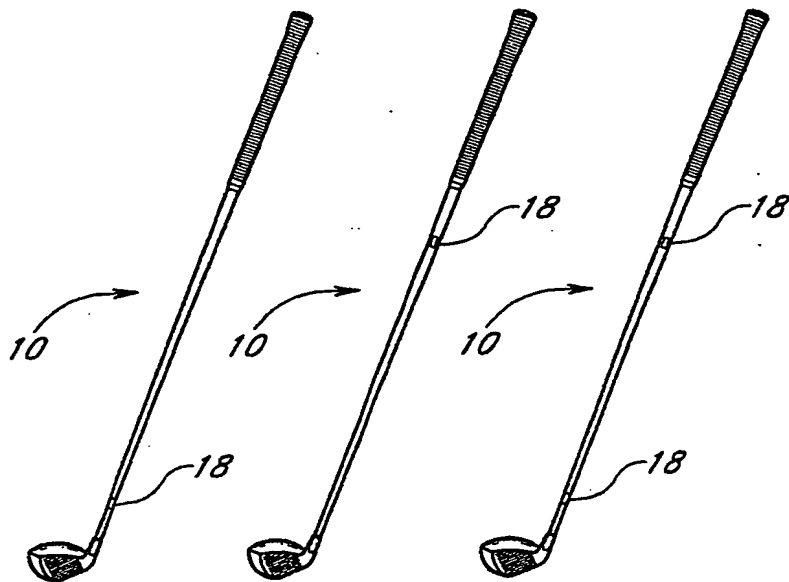


FIG. 5

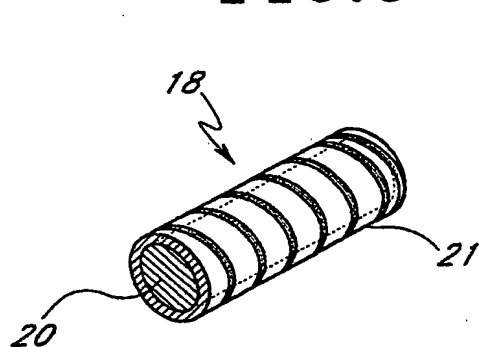


FIG. 9

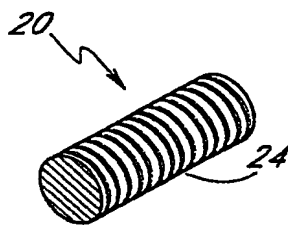


FIG. 10

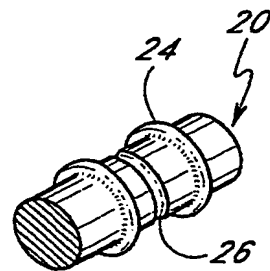


FIG. 11

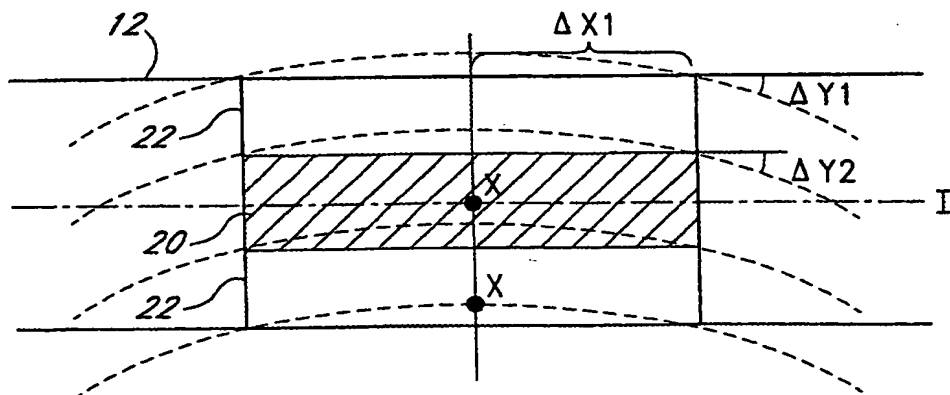


FIG. 12

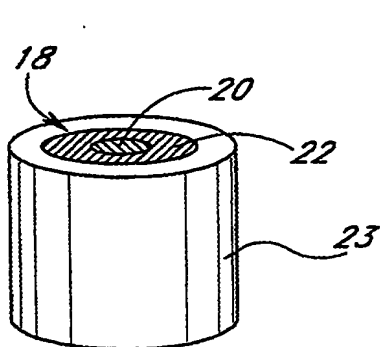


FIG. 6A

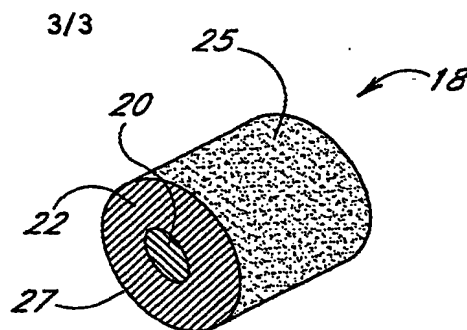


FIG. 6B

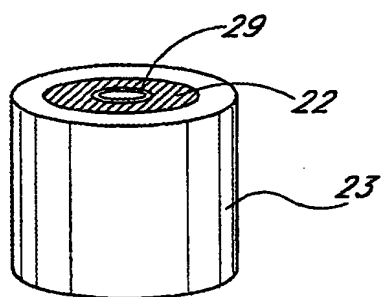


FIG. 7A

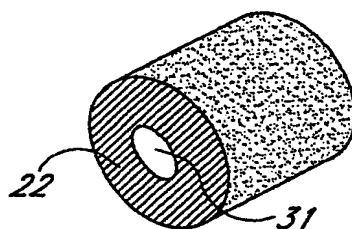


FIG. 7B

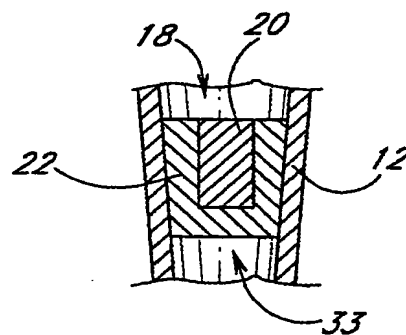


FIG. 8A

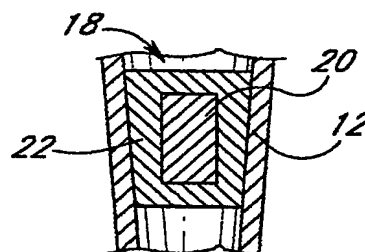


FIG. 8B

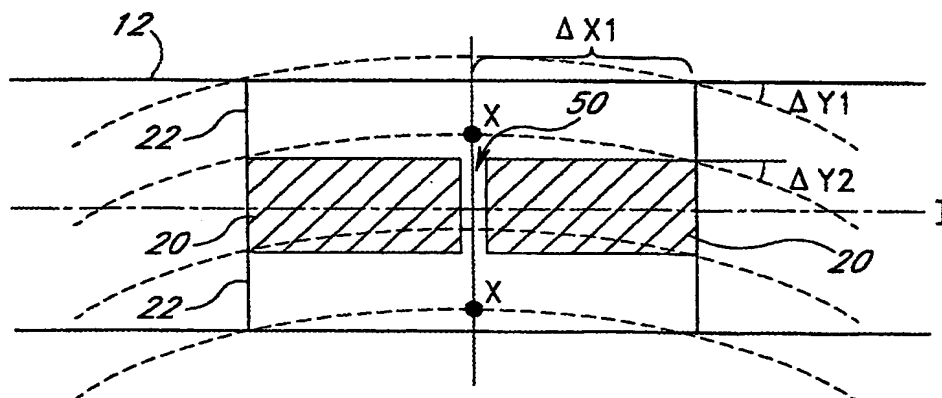


FIG. 13

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US00/31163**A. CLASSIFICATION OF SUBJECT MATTER**

IPC(7) : A63B 53/10, 53/12

US CL : 473/297, 316

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 473/297, 316, 292, 282, 318, 320, 321, 323, 558, 560, 523, 568, 521, 549

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
None

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

East: shaft, inside, insert, weight, golf

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5,716,289 A (OKONESKI) 10 February 1998, abstract, col. 3, lines 46-46, col. 4, lines 5-7, 35-37, 48-52, col. 5, lines 31-50.	1,4,10-11,1 3,16-18,20
Y		5, 8 - 9, 12, 19 21,22-26,29 - 34,36-53
Y	US 4,461,479 A (MITCHELL) 24 July 1984, col. 6, lines 16-20, 45-48, col. 7, lines 14 -21, 27-31, 37-45, col. 8, lines 22-48.	1 - 3, 6 - 9,12,15,19,22- 26,29-34,36-53
Y	US 4,674,746 A (BENOIT) 23 June 1987, col. 4, lines 1-7.	1,12,15,19,21,36
Y	US 5,788,586 A (MACIOCE) 04 August 1998, col. 3, lines 13-15, 27-33, 48-55, col. 4, lines 5-13.	1-3,6-9,22-26,29- 34,36-53

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A" document defining the general state of the art which is not considered to be of particular relevance	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E" earlier document published on or after the international filing date	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&" document member of the same patent family
"O" document referring to an oral disclosure, use, exhibition or other means	
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search

26 JANUARY 2001

Date of mailing of the international search report

22 FEB 2001

Name and mailing address of the ISA/US
Commissioner of Patents and Trademarks
Box PCT
Washington, D.C. 20231

Facsimile No. (703) 305-3230

Authorized officer

STEPHEN LUTHER BLAU

Telephone No. (703) 308-0858

Sheila Vance
Paralegal Specialist
Technology Center 3700

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US00/31163

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5,554,078 A (HANNON et al) 10 September 1996, figure 3.	12,19,21,32
Y	US 5,573,468 A (BAUMANN) 12 November 1996, figure 2.	40,42,48,50